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THE
ROUNDHEADED
APPLE-TREE
BORER



THE APPLE TREE has no more destructive insect enemy than the roundheaded apple-tree borer. It is the grub of a rather large white and brown striped beetle, which usually requires from two to three years to complete its life cycle.

It is found throughout the eastern half of the United States and southeastern Canada, attacks trees of all ages, but is most destructive to young trees up to 10 years old.

Besides the apple, it attacks the quince and pear among cultivated fruits, and the wild crab, service, mountain ash, chokeberry, seedling apple, and some other wild or native trees. The latter are frequent and unsuspected breeding places for the pest, and should be destroyed.

Some of the beetles may be killed by poison sprays; paints and washes of various kinds are partially effective in preventing the female from depositing her eggs in the bark, one of the best of these being pure white lead and linseed oil.

But the most effective and practical method of destroying the borer is the well-known practice of worming with a knife and piece of wire in mid-summer or early fall.

This bulletin describes the insect in its different stages, its habits and work, its natural enemies, and the various methods of controlling it.

THE ROUNDHEADED APPLE-TREE BORER.¹

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CHARACTER OF INJURY.

THE roundheaded apple-tree borer is, in the eastern half of the United States, the most destructive of several kinds of insects that injure apple trees by boring into the bark and wood. It is a grub hatched from eggs deposited by a rather large, white and brown striped beetle in or under the bark of the trees, usually near the ground, and feeds to such an extent on the inner bark and wood that the trees are greatly weakened and often die as a direct result of the injury. It attacks trees of all sizes, but those from

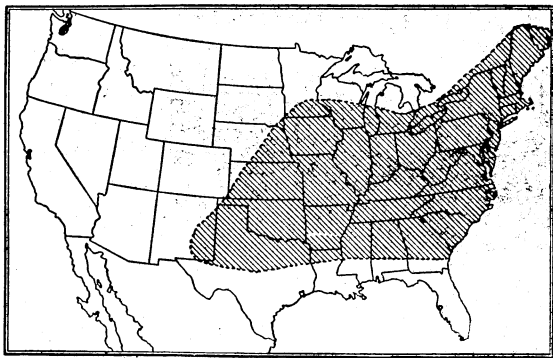


FIG. 1.—Distribution of the roundheaded apple-tree borer.

3 to 10 years old suffer most. As the borers feed they throw out, through small holes which they make in the bark, sawdustlike castings of a reddish color. (Fig. 11.) Heaps of these castings found at the base of apple, pear, or quince trees show that the trees need immediate attention. Frequently an examination of an orchard

¹ *Saperda candida* Fabricius; order Coleoptera, family Cerambycidae.

after one tree is found with castings at the base, will disclose many affected trees and that serious injury has already been done.

In many localities these borers are so abundant that practically all the trees in neglected young apple orchards are killed or injured beyond recovery before they are 10 years old. (Fig. 2.)

DISTRIBUTION.

Frequent complaints have been made of great injury by the round-headed apple-tree borer over wide areas in the eastern half of the United States and southeastern Canada. Instances of the entire destruction of apple and quince orchards by this insect are not uncommon, and the cost of protecting trees against its ravages is an important item in the expense of orchard maintenance. Its known range may be bounded by a line extending from near the mouth of the St. Lawrence River westward through Quebec and Ontario to Minnesota, thence through Nebraska, Kansas, New Mexico, Texas, Louisiana, Mississippi, Alabama, and Georgia to the Atlantic Coast. (See fig. 1.) This line, except in its southwestern extent, bounds also rather definitely the distribution in America of the service tree, which is one of the borer's favorite host trees.



FIG. 2.—Young apple tree dying from injuries caused by roundheaded apple-tree borers.

Within the range of this insect are many restricted localities where it does not occur, or is so rare as to have escaped notice. Sometimes the borers are exceedingly abundant in one orchard while in

other orchards, perhaps not more than a mile away, they may never have attracted attention. This tendency of the insect to be present in one locality and absent in an adjoining one is an interesting phase of its distribution. Where conditions favor an abundant growth of wild trees in which the borers breed, near-by cultivated trees suffer more than where such natural breeding places are not present.

As a rule the female beetle spends her adult life and provides for her progeny within a restricted area. (Fig. 3.) This accounts very largely

FOOD PLANTS.

This borer confines its attacks to a few species of trees belonging to the family Rosaceae. Quince, apple, and pear trees suffer about in the order named. Service (figs. 18, 19), wild crab, mountain ash, thorns of different species, and chokeberry are the wild or native trees which serve as its food, named about in the order of preference. Frequently a clump of these trees growing in a neglected field or those growing in the woods is infested and year after year is a source, and possibly the principal source, from which adult insects are produced to fly out and deposit eggs in adjacent orchards.



FIG. 4.—Egg punctures of roundheaded apple-tree borer in apple bark. Three punctures are to be seen. Natural size.

In exceptional cases, peach, cherry, and plum trees are said to be attacked by this species, but this occurs very rarely, the common peach borer being the grub form of an entirely different insect.

LIFE HISTORY.

To pass through the four stages of its life cycle this insect requires in some cases two years and in others three years or more. In the central part of West Virginia about two-thirds of the individuals reach the adult stage the second season after hatching, while the other third do not become adult until the third season from the egg. It is probable that throughout its northern range most or all of the

individuals require at least three years to complete the life cycle, while farther to the south, where the annual period of feeding is longer, all the borers may become adult in two years.

THE EGG AND OVIPOSITION.

The adult borers issue from the trees during late spring and early summer, the emergence of the brood in any given locality occupying from 15 to 20 days. Between the southern and northern limits of range the calendar dates of the beginning or of the ending of the emergence of adults probably vary about two months.

Emergence of the beetles from the trees takes place by day, as does the laying of most, and probably all, of the eggs. The males appear 2 or 3 days in advance of the females and usually die first. In a week or 10 days after the females issue, egg laying begins

and is continued for 40 or 50 days, a single female depositing normally from 15 to 30 eggs. In preparing a place for the egg the female uses her jaws to make a short, curved cut in the bark (fig. 4); then with her strong, extensile ovipositor she forces a side opening from the bottom of the cut (fig. 5), at the end of which a single egg is placed. During the period of egg laying a female may pass several days without depositing eggs and may then lay from 1 to 5 within an hour. Usually at least 2 or 3 eggs are laid at a time, the operations attending the laying of each following close together. The several eggs as a rule are placed in one tree. As a result, where one borer is found, others are likely to be in the same tree.

The eggs are inserted through the opening in the bark and are placed from one-fourth to one-third of an inch to one side of the entrance. In young trees they are deposited between the bark and the wood (fig. 6), but in old, thick-barked trees they may be placed between the layers of bark.

The eggs hatch in from 15 to 20 days. As a rule they are placed in the tree just above the surface of the ground. Where the female can find a crack or opening between the soil and the base of the tree

large enough to enter, she may place eggs an inch or so below the surface of the ground (figs. 7, 8). Rarely the eggs are deposited higher in the tree about a crotch or an uneven place on the trunk. In the latitude of West Virginia and Maryland egg laying is in progress from the last of May until the middle of July, the period being somewhat later in the season than these dates at the higher elevations of the mountain districts.

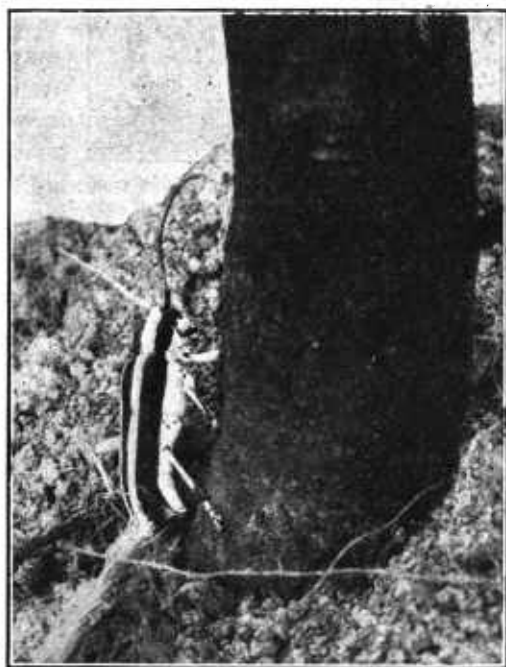


FIG. 5.—Adult female of the roundheaded apple-tree borer in the act of depositing an egg. Slightly enlarged.

THE LARVA.

The larva, or borer (figs. 9, 10), is a whitish, footless grub, with brown head and black jaws. It attains a length when full grown of



FIG. 6.—Inner surface of bark peeled from young apple tree, showing position of eggs of roundheaded apple-tree borer. Natural size.

nearly an inch and a half. On hatching, the young borers attack the inner bark, where they continue to feed until late in the season; whereupon some of them, especially in young trees with thin bark, gnaw their way into the sapwood. During the first season the young borers feed and grow rapidly, and where several occur in one tree they may completely girdle and kill it before winter. Their burrows at this time are in the form of broad, irregular, usually more or less circular galleries beneath the outer bark, near to the point where the egg was laid. The borers avoid one another in the tree, and the forms

of their galleries are often affected thereby, being made narrower and longer to avoid contact. This habit increases the liability of their being overlooked by orchardists who practice the digging-out or "worming," method.

As the borers feed they keep an open space in the burrows about themselves, thrusting their castings into abandoned corners or out through small holes made by them in the bark. These castings form little heaps of reddish, stringy wood fragments around the base of the tree (fig. 11) and afford one of the sure marks by which infested trees may be detected.

The borers spend their first winter in the burrows near the ground and resume feeding early the fol-

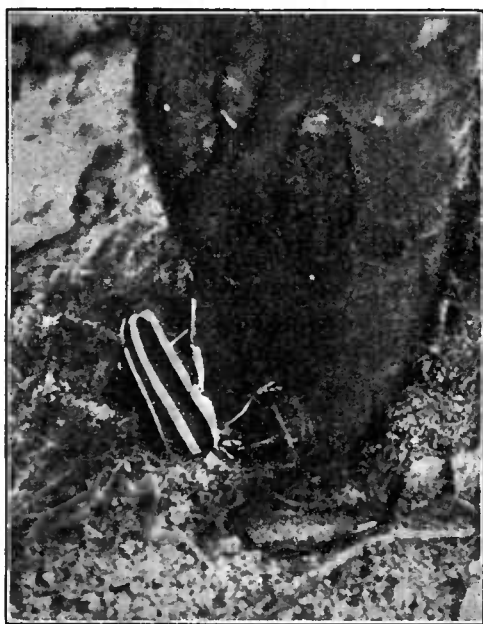


FIG. 7.—Female beetle splitting the bark of a young apple tree just below the surface of the ground preparatory to depositing an egg.

lowing spring, attacking now the solid wood almost exclusively, and, in young trees, penetrating to the heart. During the summer those that are to attain the adult stage the following year begin to extend their burrows up the trunk a half inch or more beneath the bark. As previously stated, part of the borers do not become adult until they are three years old; these remain feeding in the wood near the ground until the third summer, when they, too, work their way up the trunk in the manner just described. The winter previous to pupation or change of form is passed by the borers in the pupal cell or chamber (fig. 12). This chamber is a space at the upper end of the gallery which curves out to the inner bark above and contains in the end next to the bark a small quantity of fine, sawdust-like particles of wood. The chamber is 2 or 3 inches in length, being limited at the lower end by a packing of coarse, string-like wood fiber. In the spring the point at which the chamber extends to the inner bark begins to show from the outside as a slightly depressed, dead spot in the bark. This spot marks the place from which the adult is to issue later, and is especially noticeable on young, smooth-barked trees.

THE PUPA.

The pupa (fig. 13) is an intermediate form between the larva, or borer, and the beetle which deposits the eggs. In this form the insect is of about the same color as the borer, but the shape is greatly changed, the legs, wings, antennæ, and other appendages which the adult is to possess being now visible. The insect does not feed while in this state and is incapable of motion except that of wriggling about in the chamber. It occupies a vertical position in the tree with its head up. The change from the borer to the pupa takes place at the time apple trees are in bloom, the pupal stage lasting about 3 weeks.



FIG. 8.—Female beetle placing an egg in the tree below the surface of the ground.

THE ADULT.

The borer attains the adult stage 10 days or 2 weeks before it leaves the pupal chamber. When ready to issue it gnaws a circular hole through the bark (fig. 14) and escapes.

The beetles average about three-fourths of an inch in length, exclusive of the antennæ. The color is light brown above with two broad, white bands, joined in front, extending the full length

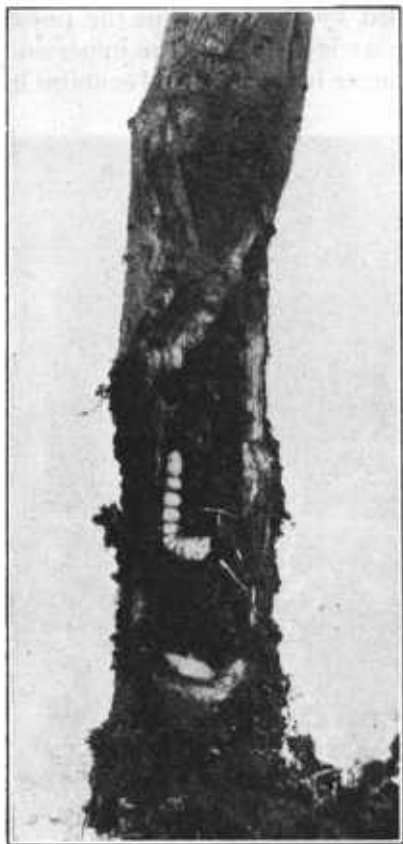


FIG. 9.—Roundheaded apple-tree borer.
First summer in tree. Natural size.



FIG. 10.—Roundheaded apple-tree borer.
Second summer in tree. Natural size.

of the back; the underparts and front of the head are white. The female is larger than the male, the body being thicker and heavier. (Fig. 15.)

All the beetles in a given locality issue from the trees within a period of 2 or 3 weeks. After they emerge they seek the branches of the trees, where they spend the greater part of their lives resting among the foliage. The females make short flights in search

of trees in which to lay their eggs. Rarely they fly for a considerable distance, but where suitable trees in which to deposit eggs are abundant they usually pass their lives within a few rods of the trees from which they issue. (Fig. 3.) The males in seeking their mates make longer and more frequent flights. Both sexes are active by day and at twilight in warm weather, and, although they occasionally fly at night, the hours of darkness are more likely to be spent in quiet among the branches.



FIG. 11.—Castings of roundheaded apple-tree borers at base of young apple tree.

The adults do considerable feeding on the bark of twigs and on the midribs and stems of leaves (fig. 16), and they also show a fondness for the moisture that is contained in castings thrown from trees by borers still in their larval stage. This habit is not important from the standpoint of any noticeable injury which such feeding does to the tree, but it causes the death of some of the beetles when they feed from trees that have been sprayed with arsenical poisons and suggests spraying with arsenicals as a possible means of combating the borers.

When ready to lay her eggs the female usually crawls down the trunk of the tree to the ground and slits the bark with her mandibles (figs. 4, 7), after which she turns around, inserts her ovipositor into the slit (fig. 5), and deposits an egg, the whole operation occupying about 10 minutes. She may deposit as many as 5 eggs without resting and will then crawl back up the trunk or move away a short distance over the ground and fly to the branches above or to a neighboring tree.

The average life of a beetle is about 40 or 50 days, although individuals occasionally live to be 70 or 75 days of age.

NATURAL ENEMIES.

Woodpeckers destroy great numbers of the borers by removing them from their burrows. The marks made by these birds in searching for borers may be found in the trunks of trees in almost any infested orchard. In some cases from 50 to 75 per cent of the borers are destroyed in this way. Most of the borers devoured are taken from the pupal chamber or while they are making the ascent of the trunk preparatory to pupation. It is rather unfortunate that the birds so often wait until the borers have done the principal part of their injury to the tree before they remove them. Probably both the hairy and the downy woodpeckers feed on the borers.

A four-winged, wasp-like parasite¹ has been reported from Indiana, but in many localities this species is doing very little to hold the borers in check.

METHODS OF CONTROL.

This insect in its borer stage lives and feeds under the bark where no poisonous or contact sprays or washes can be directed against

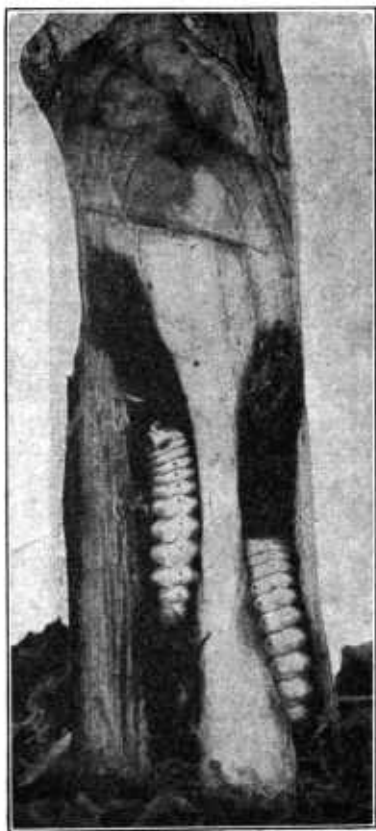


FIG. 12.—Roundheaded apple-tree borers in pupal chambers. Position occupied during winter previous to emergence as adults.

¹ *Cenocoellus populator* Say.

either its food or its body, and consequently it has always been considered a difficult pest to control. Modern insecticides have not been used so successfully against it as against many other common insect enemies of the orchard. There are practicable methods, however, whereby the borers may be destroyed, or egg laying prevented, and injury thus greatly reduced or entirely eliminated, even in orchards that have suffered severely. In the use of these methods timeliness and thoroughness are essential factors, just as they are essential in combating most insect pests.

WORMING.

Removing the borers from trees by the use of a knife and a piece of wire, a practice commonly known as worming, is one of the oldest and, when thoroughly done, one of the most effective ways of dealing with this insect. In worming trees the operator should be equipped with a strong pocketknife, a piece of small wire, a vial of carbon disulphid, a small quantity of cotton batting, and a garden trowel. (Fig. 17.) These articles may be carried very conveniently from tree to tree in a small basket. The knife should have a long, sharp blade and the wire should be bent to form a small hook at one end and a circle or ring at the other. Into the ring a scrap of white or brightly colored cloth should be tied as a safeguard against losing the wire. The trowel is for use in scraping away from the base of the tree any earth or litter that interferes with a close search for castings of the borers. When castings are found the bark should be cut away sufficiently to allow the borer to be traced by its

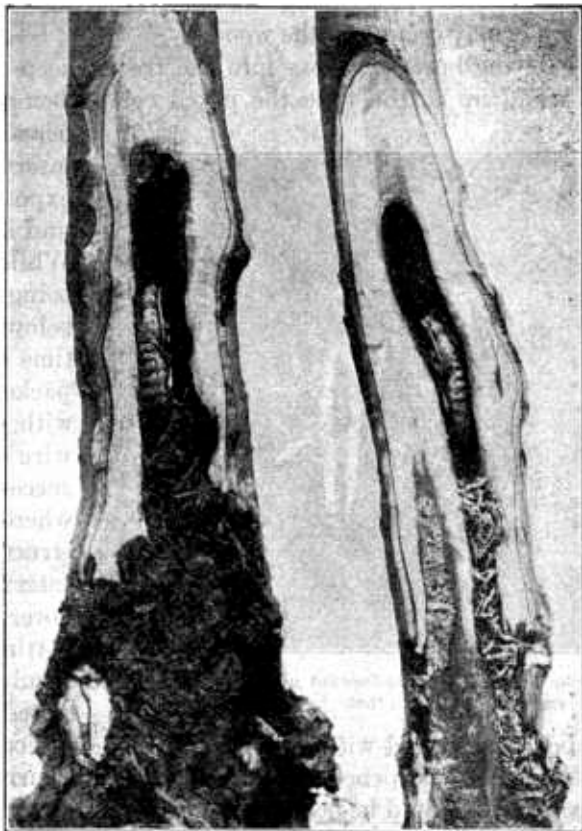


FIG. 13.—Pupæ of roundheaded apple-tree borer.

burrow and killed. If the cutting is done with care, and the borer secured, the wound will usually heal without noticeable injury to the tree. The natural healing tendency of the tree may be assisted by covering the wound with lead paint.

During the first few months of its life the borer is easily found and destroyed, but after it has been feeding a year or more the difficulty of locating it is increased, since at that time its burrow extends more deeply into the tree. With a little practice one becomes expert at securing the borer regardless of its age or the position it may occupy in the wood.

As the borer burrows into the tree it keeps a clear space behind it, and up to the time the pupal cell is being constructed there is

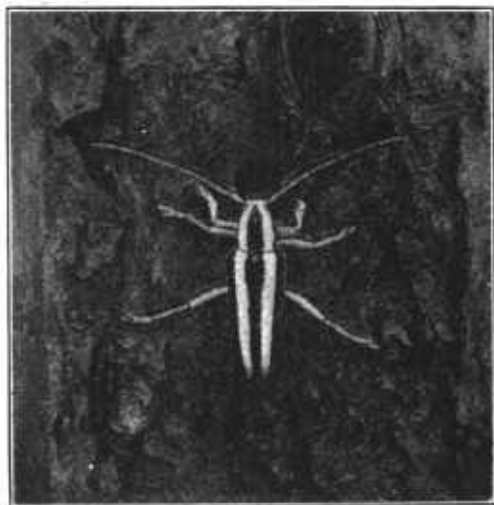


FIG. 14.—Adult roundheaded apple-tree borer just emerged from exit hole in bark. Natural size.

usually nothing to prevent inserting the wire into the exposed end of the burrow and hooking out the borer. While the pupal cell is being formed, the burrow below, which up to that time has been kept open, is packed for several inches with wood fiber so that the wire can no longer be used successfully. In all cases where curves or other obstructions in the burrows interfere with hooking the borer out, a little cotton batting dipped in carbon disulphid should be inserted into the hole and the

opening plugged with moist earth. The gas coming from the carbon disulphid will penetrate all parts of the burrow and will kill the borer. It should be borne in mind that the gas is highly inflammable and that fire should be kept away.

In extensive orchards where worming is done on a large scale some of the helpers are likely to become careless and overlook or neglect to destroy an occasional borer. Every female so overlooked stands a good chance of maturing within a year or two, when she will deposit eggs in a half dozen or more near-by trees, causing thereby a continued and an increased infestation in that particular part of the orchard.

The importance of the following points should be kept in mind by all persons who practice this method of borer control:

1. Borers should be removed from the trees as soon as possible after hatching.

2. Every borer in the orchard should be found and destroyed.

3. Borers should not be allowed to breed in cultivated or wild trees within at least 200 or 300 feet of the orchard.

Many orchardists put off the fall worming of trees until after winter apples are gathered. This practice permits the borers, which feed rapidly while young, to remain in the trees too long for safety. Even in so short a time small trees may be girdled and killed and larger trees injured seriously. In the latitude of West Virginia and Maryland the work should be done not later than September 1; farther south it may be done several weeks or a month earlier, and north of the States mentioned the time will be correspondingly later. A second examination should be given the trees the following spring to secure borers from belated eggs or those that may have been overlooked at the fall worming.

The fact that the adult female does not habitually wander far in depositing her eggs (see fig. 3) is greatly to the advantage of the orchardist who depends on worming to save his trees. When once his orchard and all surrounding host trees are cleared of the borers he is likely thereafter to be troubled very little by new infestations so long as adults are kept from developing within the area. He should continue his examinations of the trees every year, however, to detect in time any fresh outbreaks arising from eggs deposited by adults that may occasionally fly into the orchard from a distance. Where this method is used all worthless trees in which the borers can breed, growing within a few hundred feet of the orchard, should be removed. This would include service (figs. 18, 19), mountain ash, wild crab, and thorn trees in woods, as well as cultivated fruit trees.

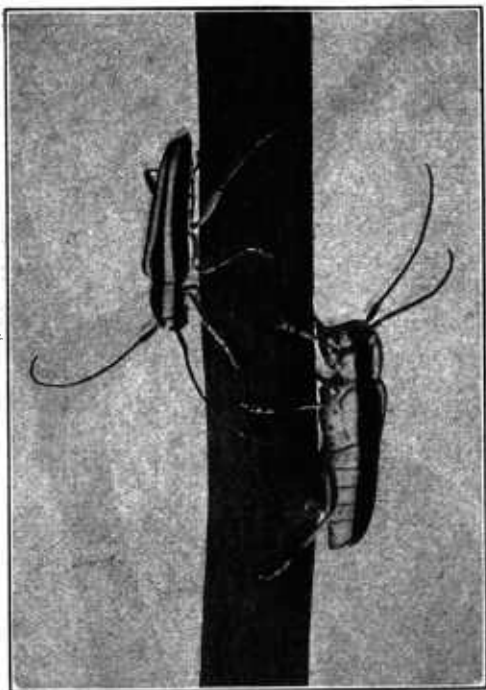


FIG. 15.—Adult male and female of the roundheaded apple-tree borer. Male on left, female on right. Slightly enlarged.

PAINTS AND WASHES.

Paints and washes of various kinds have frequently been recommended for use on the trunks of trees, both to prevent the beetles from depositing eggs and to kill the borers within the trees. It is easier by such means to prevent the eggs from being laid than to kill the borers. Some orchardists report success by applying pure kerosene to the bark of affected trees at the places where castings show borers to be at work. The kerosene is sup-

posed to penetrate the burrow to the insect and kill it. Others have found that this treatment does not destroy enough of the borers to make the remedy worth while, and that in addition the kerosene may kill the bark at the point of application. The danger of injury to trees by the use of kerosene or other mineral oil practically prohibits the use of these substances. Milder solutions, applied in the same way, while not so likely to injure the trees, are even less fatal to the borers.



FIG. 16.—Twig and leaf of apple gnawed by adult round-headed apple-tree borer.

On the other hand, a heavy application, made just before the beginning of the egg-laying season, of some thick paint that will not injure the trees and that will maintain an unbroken coat on the bark for 2 or 3 months is very effective in preventing the female from placing her eggs in the bark. The beetle in slitting the bark with her jaws, preparatory to inserting the egg, will very rarely make an opening through such a thick coat of paint.

Before applying paint for this purpose the earth around the base of the tree should be removed with a garden trowel or hoe to a depth

of 3 or 4 inches. Bark scales and adhering earth should then be scraped from the space to be covered, and the paint applied with a brush in the form of a band around the tree extending about a foot up the trunk and 2 or 3 inches below the level of the ground. After the paint is dry the earth removed in the beginning should be replaced. The painting may be done more thoroughly and economically by two persons working together on opposite sides of the tree.

The deterrent effect of the paint seems to arise from the mechanical barrier it presents rather than from malodorous or distasteful properties. The paint should cover the treated portion of the tree in a thick, solid coat, with no cracks or unpainted spaces left, as the beetles will seek out such openings in which to lay their eggs. Any noninjurious paint that will form a coat of the nature described will answer the purpose. A paint of pure white lead and raw linseed oil, mixed somewhat thicker than for ordinary use, will afford a fair measure of protection to the tree, providing a heavy coat is applied in a thorough manner just previous to the beginning of the egg-laying season of the borers. The natural growth of the tree will in time cause the paint to crack, but the coat formed by one painting will remain intact and protect the tree during one egg-laying season if applied at the proper time. Better results are likely to be obtained from this treatment on young,



FIG. 17.—Tools for use in removing roundhead apple-tree borers from burrows.

smooth-barked trees than on old trees on which the rough bark makes a thorough job of painting more difficult. In the experience of the Bureau of Entomology, apple trees are not injured by the white-lead paint when used as directed. Others have reported injury from supposedly pure white-lead paints, but it is possible that these contained foreign and injurious substances. Those planning to use the raw linseed oil and

white-lead paint should insist on receiving the pure article. Several so-called tree paints and pruning paints on the market are valuable for this purpose and appear to be safe for the trees. Annual applications of any of these paints will be necessary.

Gas tar has been used with some success against peach-tree borers, but should be used with caution on apple trees, as there is serious danger of injury to the bark and wood. Axle grease and paints con-



FIG. 18.—Clump of service bushes showing exit holes of roundheaded apple-tree borers.

taining considerable quantities of benzine or turpentine can not be used on apple trees with safety. Some have had good success from the use of fish-oil soaps and carbolic-acid washes, but in tests made by the Bureau of Entomology these have not proved beneficial.

MECHANICAL PROTECTORS.

Various mechanical protectors or coverings, to be placed around the lower portion of the trunk for the purpose of excluding the

female beetle from the bark, have been devised. Wrappers made of newspapers are quite effective for this purpose. These wrappers, or any protectors of like nature, should be placed around the base of the trunks early in May, the season varying with the locality, and should cover the trunk from a foot or so above the ground to a short distance beneath the surface. The earth at the bottom should be mounded around the protector so as to leave no exposed portion of bark at that point. Building paper, cloth, cotton batting, fine-meshed wire screen, moss, and other materials may be used in the same way with success. Tarred paper has been recommended, but tests have shown that trees wrapped with it are likely to be injured.

Such devices as those just described should be tied at the top close to the body of the tree, preferably with a piece of twine, to prevent the beetles from crawling down to lay their eggs between the trunk and the covering. These protectors have the disadvantage of furnishing breeding and harboring places for the woolly aphis, an insect destructive to apple



FIG. 19.—Roundheaded apple-tree borers working in young service tree.

trees, and for that reason they should be removed from the trees as soon as possible after the egg-laying season of the borer is past. It is probably safe to remove them in any locality by September 1. Eggs will be deposited occasionally around the upper margins of

the protectors, but the resultant borers are easily located and destroyed. It is doubtful whether trees can be protected as economically with devices of this kind as with paint, and since paint of the proper kind is of almost or quite as much value in preventing attack, it may often be used in preference to the other form of covering.

SPRAYING WITH ARSENICALS TO KILL ADULTS.

As is stated on page 11, the borer in its adult stage feeds more or less on the exposed surface of leaves and twigs (fig. 16) and on the moisture contained in fresh castings thrown out by borers still working in the trees. The quantity of food taken in this way is sufficient to enable the beetles to be killed by spraying with arsenate of lead the trees on which they are feeding. It is doubtful whether it would pay ordinarily to spray orchards for the sole purpose of killing this insect, but in exceptional cases, where orchards are badly infested and are not surrounded by prolific breeding places, there is little doubt that the treatment would be profitable. Fortunately the beetles are active at the season of the year when arsenical sprays for the codling moth and other orchard pests are usually applied. These sprays, used primarily to destroy other enemies of the orchard, without doubt kill incidentally many adult roundheaded apple-tree borers.